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(21) International Application Number: PCT/SE91/00475 (22) International Filing Date: 3 July 1991 (03.07.91) (30) Priority data: 9002339-1 4 July 1990 (04.07.90) SE (71) Applicant (for all designated States except US): KABI PHARMACIA AB [SE/SE]; S-751 82 Uppsala (SE). (72) Inventors; and (75) Inventors/Applicants (for US only) : EDMAN, Peter [SE/SE]; Gitarrvägen 47, S-756 54 Uppsala (SE). KRISTENSEN, Arne [DK/SE]; Askvägen 22 A, S-756 53 Uppsala (SE). WIDEHOLT, Bengt [SE/SE]; Nöthårsvägen 21, S-752 57 Uppsala (SE).	(74) Agents: WIDÉN, Björn et al.; Kabi Pharmacia AB, S-751 82 Uppsala (SE). (81) Designated States: AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FI, FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), NO, SE (European patent), US. Published With international search report.	
(54) Title: THERAPEUTICAL COMPOSITION AND PROCESS FOR ITS PREPARATION (57) Abstract A colon selective pharmaceutical composition for oral delivery of one or more therapeutically active substances, comprises (i) a matrix core having the active substance or substances dispersed therein, and (ii) an outer cover layer without any active substance, said matrix core and cover layer being selectively degradable by enzymes normally occurring in the colon. A method of preparing such a colon selective pharmaceutical composition comprises the steps of mixing at least one therapeutically active substance with a matrix material to prepare a matrix core having the active substance or substances dispersed therein, and coating said matrix core with a material without any active substance therein to provide the matrix core with a drug-free protective cover layer, said matrix and cover layer materials being based upon at least one substance which is selectively degradable by enzymes in the colon.		

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THERAPEUTICAL COMPOSITION AND PROCESS FOR ITS PREPARATION

The present invention relates to a novel colon selective pharmaceutical composition as well as to a process for its preparation.

The conventionally used pharmaceutical compositions for oral delivery of drugs which are to exert their activity locally in the colon are not quite satisfactory. For example, they release a considerable amount of the active component already on their way to the colon tract and/or the release of the active component is too slow once the composition has reached the colon.

The present invention aims at overcoming the deficiencies of the prior art compositions by providing an improved colon selective composition which substantially retains the drug within the composition matrix until it reaches the colon, at which time the drug is quickly and efficiently released, as well as a process for the preparation of such a composition.

According to a first basic concept of the present invention, a pharmaceutical composition for oral delivery of a therapeutically active substance has the latter dispersed in a matrix material core, at least a substantial part of which is selectively degradable by the enzymes normally occurring in the colon, thereby providing for rapid decomposition of the matrix and momentary release of the active substance(s) dispersed therein once the composition has reached the colon.

According to a second basic concept of the invention, the matrix core is provided with a protective cover layer having no therapeutically active substance dispersed therein, which protective cover layer also is selectively degradable in the colon. Such a cover layer will serve as a protective or wear layer during the transport of the composition through the gastro-intestinal tract and prevent leakage of the active substance(s) from the matrix core into the surrounding medium.

Thus, in one aspect the present invention provides a colon selective pharmaceutical composition for oral delivery of one or more therapeutically active substances, comprising (i) a matrix core having the active substance(s) dispersed therein, and (ii) an outer cover layer without any active substance dispersed therein, said matrix core and cover layer being selectively degradable by enzymes normally occurring in the colon, such that the composition substantially will retain the active substance(s) therein until it reaches the colon, when the active substance(s) will be released.

In another aspect the present invention provides a method for the preparation of such a colon selective pharmaceutical composition for oral administration, comprising the steps of (i) mixing one or more therapeutically active substances with a matrix material to prepare a matrix core having the active substance(s) dispersed therein, and coating said matrix core with a material without any active substance dispersed therein to provide the matrix core with a drug-free protective cover layer, said matrix and cover layer materials being based upon substances selectively degradable by enzymes in the colon.

While a matrix core selectively degradable by colonic enzymes will efficiently release the active substance(s) once the composition has reached the colon, the provision of a drug-free cover layer non-permeable for the active substance(s) and which is also selectively enzymatically degradable in the colon but resistant to the conditions prevailing in the stomach and small intestine, will prevent leakage of active substance from the coacervate matrix, especially if the active substance is soluble in water, and also strengthen the matrix mechanically. Such coating will thus provide for protection against both physical and chemical activity in the passage of the composition form through the upper parts of the gastro-intestinal tract.

Preferably, the matrix, and advantageously also the cover layer, are based upon one or more polysaccharides

selectively degradable by enzymes in the colon. By the term "based upon" as used herein in the present context is meant that the matrix contains sufficient degradable component for the coated matrix to be efficiently disintegrated when
5 subjected to the enzymatic attack in the colon.

When the protective cover layer comprises a polysaccharide, or a mixture of polysaccharides, which like the matrix core is capable of being selectively degraded in the colon, this or these polysaccharides may be the same
10 as, or comprise the polysaccharide(s) forming the enzyme degradable part of the matrix core, but may also be or comprise other colon-degradable polysaccharides.

It has recently been discovered that the colonic tract contains inter alia pectinase activity, and since some
15 pectins have been found to be useful for coacervation procedures, suitable polysaccharides for the purposes of the invention comprise such pectins and salts and derivatives thereof.

An enzymatically degradable polysaccharide based
20 matrix core and cover layer may, in addition to such polysaccharide(s), also comprise one or more additional substances or fillers which may, but do not have to be, degradable by the enzyme systems of the colon. Exemplary of such fillers are other polysaccharides, e.g. dextrans,
25 alginates and gum arabic, celluloses, e.g. methylcellulose, and derivatives thereof. An advantageous matrix material combination for the purposes of the invention is pectin and dextran, dextran splitting enzymes also being present in the colon.

30 The active substance or substances to be dispersed in the matrix may be any drug or drug combination which is desired to exert its activity in the colon, particularly for the treatment of inflammatory bowel disease, such as ulcerous colitis. As examples of such drugs may be
35 mentioned especially anti-inflammatory steroids, but also substances like sulfasalazine, olsalazine, 5-ASA, etc.

The composition of the invention is, however, not only useful for local delivery of therapeutical substances for

activity in the colon, but also for systemic delivery of therapeutical substances for which it may be desirable that they are released in the colon, e.g. stomach irritant drugs.

5 In a suitable administration form, the pharmaceutical composition according to the present invention is in the form of pellets placed in a gelatine capsule.

In a preferred embodiment of the invention, the polysaccharide based matrix core containing the
10 therapeutically active species, and preferably also the cover layer, is of coacervate type, and particularly a coacervate prepared by so-called ionotropic coacervation, as will be described in more detail below. Such a
15 coacervate matrix and cover layer will readily provide for the desired properties, i.e., on one hand, being capable of having the drug effectively dispersed in the matrix, and, on the other hand, having such a structure that will favour the required rapid enzymatic degradation and disintegration of the matrix and cover layer when the enzyme degradable
20 polysaccharide chains are cleaved.

Coacervation techniques for the preparation of pharmaceutical compositions have been used in the prior art, the purpose thereof, however, mainly being to provide slow-release administration forms. Encapsulation procedures
25 for various substances using coacervation techniques are, for example, generally described in GB-B-929 406; GB-B-929 401; US-A-3,266,987; US-A-4,794,000 and US-A-4,460,563.

With specific reference to ionotropic coacervation, it may be referred to, for example, FR-B-2 042 034, disclosing
30 the production of caviar imitating products, and WO 87/04350, which discloses the separate application of two components, capable of forming a coacervate gel, to the same area of a mucous membrane to thereby achieve improved adherence. Further, EP-A-357 793 discloses slow-releasing
35 alginic acid coacervate gel beads containing a medicament. EP-A-202 819 discloses a drug delivery system based upon a drug entrapped in a cross-linked multivalent cation alginate or carageenenate matrix. US-A-4,024,073 discloses

a polyvalent metal ion cross-linked polymer hydrogel for timed release of drugs and medicaments. JP-A-6104480 discloses an outer coat for soft capsules, which coat is prepared by cross-linking a polysaccharide with a bivalent cation.

A colon selective pharmaceutical composition of the invention having a coacervate matrix may thus be prepared by reacting, in the presence of the drug to be dispersed in the matrix, a cation reactive polysaccharide, capable of being degraded enzymatically in the colon, with a polyvalent cation to form a coacervate by non-covalent complexing, i.e. by forming cationic connections between the polysaccharide chains, and then coating the resulting matrix core with a drug-free cover layer, preferably also as a polysaccharide coacervate.

More particularly, such a process may comprise the steps of:

- a) providing a first solution containing at least one cation reactive polysaccharide capable of being selectively degraded by enzymes in the colon, said solution having at least one therapeutically active component dispersed or dissolved therein,
- b) dropwise adding said first solution to a second solution containing at least one member selected from polyvalent, preferably bi- and trivalent cations to form coacervate globules of the cation reactive polysaccharide(s) complexed with said cation(s), said coacervate globules having said at least one therapeutically active component dispersed therein, and
- c) contacting the resulting coacervate globules with a third solution containing at least one cation reactive polysaccharide capable of being selectively degraded by enzymes in the colon, said polysaccharide(s) reacting with an excess of cations in the coacervate globules to form a coacervate cover layer thereon without said therapeutically active component, and optionally drying the resulting coacervate coated globules.

The solution in step a) above may also contain one or more enzyme degradable polysaccharides which are not cation reactive, these non-reactive polysaccharides then forming enzyme degradable building blocks entangled in the
5 coacervate formed. The proportion of such cation non-reactive polysaccharide(s) may vary, but may well exceed that of the cation reactive one(s), the only restriction being that the latter should be present in a sufficient amount to form a coacervate structure that will keep the
10 matrix together. In accordance with the preceding description a suitable example of such a polysaccharide is dextran or a derivative thereof.

The cation reactive enzyme degradable polysaccharide is preferably a pectin or salt or derivative thereof, such
15 as e.g. potassium pectate.

Examples of bi- or trivalent cations that may be used in the coacervation process of the invention are Ca^{2+} , Mg^{2+} , Al^{3+} , Fe^{2+} , Fe^{3+} .

In the formation of an outer cover layer based upon an
20 enzyme degradable polysaccharide or polysaccharide mixture in step c) above, the globules obtained in step b) are preferably washed before being treated with an aqueous solution containing the at least one cation reactive and colonic enzyme reactive polysaccharide. As in the case of
25 the preparation of the drug containing matrix core, the polysaccharide solution may also contain an additional enzyme degradable polysaccharide or polysaccharide combination which is not cation reactive, as well as one or more other filler substances. In this way a spherical drug-
30 free coacervate outer layer will result from the polysaccharides reacting with the polyvalent cations already present in the matrix, i.e. cations which have penetrated into the coacervate globules by the osmotic pressure arisen in the coacervation process and which are
35 in excess in the globules. These cations will then be exuded from the globules and react with cation reactive polysaccharide(s) on the globule surfaces to form a coacervate shell around the globules.

A drug-containing coacervate globule or pellet having an outer drug-free polysaccharide based layer produced as described above will contain polysaccharide chains interconnected by the polyvalent cations used for the coacervation. In the stomach of a patient having a normal gastric acid function, hydrogen ions will penetrate into both the outer layer and the core of the pellet and by ion-exchange substitute hydrogen ions for the polyvalent cations, leaving the polysaccharide chains non-complexed to a great extent and more or less keeping together by sterical effects rather than by cation connections. In fact, such removal of the cation connections has been found to be highly favourable for the pellet matrix core and cover layer to be readily disintegrated in the colon when the polysaccharide chains are cleaved enzymatically and thereby provide for momentary release of the drug dispersed therein.

The process for the preparation of the coacervate pellet (the term pellet herein refers to the dried form) therefore preferably includes a post-treatment of the pellet, or the coacervate globule before it is dried to a pellet, with hydrogen ions to ensure that the enzymatic cleavage in the colon will lead to adequate decomposition of the coacervate matrix core and outer cover layer and rapid release of the drug even in patients suffering from a low content of hydrogen ions in the stomach. The degree of ion exchange will, of course, depend on the hydrogen ion concentration and the contact time. In case the pellet contains dextran, the hydrogen ion containing solution preferably also contains a sufficient concentration of dextran to prevent release of dextran from the pellet.

It will be appreciated that in a patient having an abnormally high hydrogen ion concentration in the stomach, the removal of the cation connections, especially in an outer protective coacervate layer, could be too excessive and weaken the matrix core and protective layer, respectively, thereby reducing the resistance of the pellet to mechanical damage in its passage through the stomach and

small intestine. Thus, to make the outer coacervate protective layer capable of withstanding a high hydrogen ion concentration in the stomach and simultaneously increase the mechanical strength of the coacervate globule or at least the outer protective coacervate layer, a post-treatment of the, optionally hydrogen ion treated, coacervate globules with polyvalent cations may be performed prior to their being dried to pellets. By such cation treatment, which is to be carried out with a higher cation concentration than in the coacervation process, more charged COO^- groups in the polysaccharide will react with the multivalent ions and in this way the polysaccharide chains will be interconnected to a higher extent. Accordingly, the more coupling points there are between the polysaccharide chains, the higher hydrogen ion concentration will the protective cover layer withstand without being weakened during the passage of the pellet through the stomach.

Such strengthening of the outer protective layer by cation treatment will, however, this being at least as important, make the layer more resistant to damages during the following processing steps, i.e. washing and drying.

In the case of, for example, a pectin coacervate, the outer protective cover layer may also be strengthened by a treatment with potassium ions, e.g. a KCl/CaCl_2 solution, potassium ions increasing the gel strength of pectins.

The chemical and mechanical properties of the pharmaceutical pellet produced may consequently be controlled by the above described procedures of hydrogen ion and/or cation treatment. A pellet comprising a drug-free coacervate protective coating and optionally subjected to either or both of the above post-treatments may, of course, be protected further, if desired, by the application of a conventional enteric coating. It will be appreciated that such an enteric coating applied to a pellet which has been post-treated with hydrogen ions will retain the complexing degree in the pellet unchanged during the transport thereof all the way down to the colon where

the coating is dissolved and the pellet thereby is exposed to the desired enzymatic attack.

The colon selective composition of the invention may, of course, also be prepared by other methods than
5 coacervation techniques, as will readily be realized by the skilled person.

A coacervation procedure in accordance with the invention may in a general embodiment thereof be performed by dissolving the cation reactive polysaccharide, e.g.
10 potassium pectate (preferably low molecular esterified, i.e. part of the carboxylic groups being e.g. methyl esterified), optionally together with additional enzyme degradable polysaccharide(s) and/or non-degradable fillers, in water to form an aqueous solution thereof. The drug or
15 drugs are then added to the solution to be dissolved or dispersed therein, whereupon the resulting solution or dispersion preferably is degassed by subjecting it to vacuum. The solution is then dropped into an aqueous or alcoholic solution containing cations of bi- or trivalent
20 charge, the drops solidifying in the reaction between the cation reactive polysaccharide and the cations.

The spheres or globules formed hereby are then provided with a protective cover layer by treatment with a solution of a cation reactive polysaccharide, such as the
25 above potassium pectate, optionally with the addition of some other polysaccharide(s)/polymer(s) as filler. To this end the spheres may, by way of example, be treated as follows:

1. Washing with water.
- 30 2. Treatment with an aqueous solution of potassium pectate and another polysaccharide.
3. Washing with water.
4. Treatment with a solution of bi-/trivalent cations or hydrogen ions.
- 35 5. Washing with water.
6. Optionally washing with ethanol.
7. Drying to pellets.

The resulting pellets may then optionally be treated with hydrogen ions (e.g. hydrochloric acid 0.001-10 M) for more than 0.1 min., optionally with vacuum and/or pressure, whereupon they are washed with distilled water and dried.

- 5 Such hydrogen ion treatment may, alternatively, be performed prior to drying the spheres to pellets.

The invention will now be described further by way of some non-limiting specific examples, reference also being made to the accompanying drawing, in which Fig. 1 is a
10 diagram showing the drug release from colon selective drug pellets of the invention in different surroundings.

Recipes

Examples of basic recipes for the matrix, cation solution and protective cover layer, respectively, will
15 first be given, indicating both the specific quantities of the respective ingredients used in the following preparation examples and generally usable ranges of the ingredients.

20	<u>Basic recipe for matrix:</u>	<u>Limits</u>
	Distilled water 192 g	192 g
	Potassium pectate 8 g	0.01 - 20% w/w of water
	Pectin 0 g	0 - 5% w/w of water
25	Avicel (microcrystal-line cellulose) 0 g	0 - 8% w/w of water
	Dextran 50 g	0% w/w of water to sat. solution
	Drug 1 g	0.01 - 50% w/w of water
30	Temperature 0 - 100°C	

	<u>Basic recipe No. 1 for cationic solution</u>	<u>Limits</u>
35	Calcium chloride 20 g	0.001% w/w of water to sat. solution
	Distilled water 980 g	980 g

<u>Basic recipe No. 2 for cationic solution</u>		<u>Limits</u>
Calcium chloride	20 g	0.001% w/w of ethanol to sat. solution
5 Ethanol	980 g	980 g

<u>Basic recipe for protective layer</u>		<u>Limits</u>
Distilled water	192 g	192 g
Potassium pectate	1 g	0.001 - 20% w/w of 10 water
Pectin	0.25 g	0 - 15% w/w of water
Avicel	0 g	0 - 8% w/w of water
Dextran	10 g	0% to saturated aqueous solution

15

Example 1: Budesonide composition

The basic recipe given above for the matrix is used with the exception that the amount of dextran is 20 g.

The potassium pectate, dextran and drug, here
20 Budesonide, are thoroughly mixed. The powdery mixture obtained is added to the distilled water with vigorous stirring. The temperature is preferably maintained between 20 and 25°C. The resulting solution is stirred to dissolve or suspend all powder and is then placed under high vacuum
25 for about 30 min., whereupon the solution is added dropwise to a 2 % w/w aqueous calcium chloride solution.

The coacervate spheres formed are then coated with a protective cover using a solution prepared according to the above given basic recipe therefor. Thus, the potassium
30 pectate, pectin and dextran are dissolved in the distilled water. After the spheres have been washed with water they are treated with the solution just prepared.

The resulting coacervate spheres are post-treated by any one of the following procedures:

35 1. The coacervate spheres are thoroughly washed with distilled water and dried to pellets.

2. The coacervate spheres are thoroughly washed with distilled water and shortly, 5 - 15 sec., with alcohol and are then allowed to dry to pellets.

3. The coacervate spheres are thoroughly washed with
5 distilled water and the spheres are then treated with 0.001 - 10 M hydrochloric acid, here specifically 0.1 M hydrochloric acid, for more than 0.1 min., optionally under vacuum and/or pressure. The spheres are then washed and dried to pellets.

10 4. The coacervate spheres are washed and dried to pellets which are then treated with 0.001 - 10 M hydrochloric acid, here specifically 0.1 M hydrochloric acid, for more than 0.1 min., optionally under vacuum and/or pressure. The spheres are then washed and dried to
15 pellets.

5. The coacervate spheres are treated with a cation solution prepared as defined in basic recipe No. 1 or 2 for the cationic solution above, for more than 0.1 min. The spheres are then washed with distilled water and optionally
20 with ethanol and subsequently dried to pellets.

Example 2: Budesonide composition

A matrix is prepared from 192 g of distilled water, 16 g of potassium pectate and 1 g of Budesonide in the same way as in Example 1. The resulting coacervate spheres are
25 then optionally post-treated in accordance with any one of the post-treatment procedures 1 to 5 in Example 1.

Example 3: Budesonide composition

A matrix is prepared as in Example 1 and 2, using the basic matrix recipe given above with Budesonide as the
30 drug, except that 1 g of Avicel is included and the dextran is omitted.

Example 4: Olsalazine sodium composition

8 g of potassium pectate and 1 g of olsalazine sodium are thoroughly mixed, and the powdery mixture is then added
35 to 192 g of distilled water with vigorous stirring, suitably at a temperature between 20 and 25°C. The resulting solution is stirred such that all powder is dissolved and is subsequently placed under high vacuum for

about 30 minutes. The degassed solution is then dropwise added to a 2 % calcium chloride solution in 99.5 % ethanol. The coacervate formed is washed with ethanol and dried to pellets. A protective coacervate cover layer is applied prior to drying. The resulting pellets may be post-treated with 0.001 - 10 M hydrochloric acid as in post-treatment procedure 4 in Example 1.

Example 5: Hydrocortisone composition - in vitro test

A matrix was prepared as described in Example 1 from 192 g of distilled water, 8 g of cation reactive potassium pectate (Genu Pectin LM111CSZ, supplied by A/S Københavns Pektinfabrik, Copenhagen, Denmark) and 4 g of hydrocortisone. The coacervate spheres obtained were then provided with a protective cover layer as described in Example 1 using a mixture of 192 g of distilled water, 6 g of cation reactive potassium pectate (Genu Pectin LM111CSZ) and 2 g of non-reactive pectin (Genu Pectin Type DD) which mixture had been diluted with 9 times its weight of distilled water.

The resulting coated pellets were then subjected to an in vitro test designed to simulate the passage of the pellets through the gastro-intestinal tract. In this test the pellets were sequentially treated in 0.1 M HCl for 120 minutes, in phosphate/citrate buffer, pH 7.0, for 120 minutes and finally in the presence of pectolyase. The hydrocortisone released to the surrounding solution was monitored during the test by UV measurements. The results are illustrated in the accompanying drawing figure 1. From the figure it may be seen that the release of hydrocortisone is low in 0.1 M HCl (resembling the conditions in the stomach) and in phosphate/citrate buffer (resembling the conditions in the small intestine). In contrast, the release is considerably increased in the presence of pectolyase, simulating the conditions in the colon.

Example 6: Steroid composition

Coacervate spheres were prepared as described in Example 1 from, on one hand, a pectate solution consisting

of: 200 g of distilled water, 4 g of cation reactive potassium pectate (Genu Pectin LM111CSZ, supplied by A/S Københavns Pektinfabrik, Copenhagen, Denmark), 2 g of non-reactive pectin (Genu Pectin Type DD), 8 g of Avicel, 18 g of Dextran T70 (Kabi Pharmacia AB, Uppsala, Sweden), and 3.1 g of steroid (Budesonide); and, on the other hand, a calcium chloride solution consisting of: 26.5 g of $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$, 70 g of Dextran T70, and distilled water q.s. to 1000 g. After washing with water, a protective cover layer was applied to the spheres formed by treatment, as in Example 1, with a surface polymerizing solution consisting of 200 g of distilled water and 6 g of reactive potassium pectate (Genu Pectin LM111CSZ). The mixture was diluted 1:7 prior to use. The coated spheres were then washed with water and subsequently with ethanol, dried and treated for 2 hours with a mixture of 100 g of 0.12 M hydrochloric acid and 18 g of Dextran T70. After wash with water and then ethanol, the spheres were dried and filled into gelatine capsules.

CLAIMS

1. A colon selective pharmaceutical composition for oral delivery of one or more therapeutically active substances, comprising (i) a matrix core having the active substance or substances dispersed therein, and (ii) an outer cover layer without any active substance, said matrix core and cover layer being selectively degradable by enzymes normally occurring in the colon.
2. The composition as claimed in claim 1, wherein said matrix core, and preferably also said cover layer, are based upon at least one polysaccharide selectively degradable by colonic enzymes.
3. The composition as claimed in claim 1 wherein at least one of said enzymatically degradable polysaccharides forms a coacervate, preferably through polyvalent cation cross-linking.
4. The composition as claimed in claim 2 or 3, wherein said enzyme degradable polysaccharide or polysaccharides are selected from the group consisting of pectins and salts and derivatives thereof.
5. The composition as claimed in claim 3 or 4, wherein at least one of said matrix core and said cover layer, in addition to said coacervate forming polysaccharide or polysaccharides, comprises one or more colonic enzyme degradable polysaccharides which are not involved in the coacervate formation.
6. The composition as claimed in claim 5, wherein said one or more additional polysaccharides comprise dextrans and derivatives thereof.
7. The composition as claimed in any one of claims 1 to 6, wherein at least one of said matrix core and said cover

layer comprises one or more filler substances that are not enzymatically degradable in the gastro-intestinal tract.

8. A method of preparing a colon selective pharmaceutical composition for oral administration, comprising the steps of (i) mixing at least one therapeutically active substance with a matrix material to prepare a matrix core having the active substance or substances dispersed therein, and (ii) coating said matrix core with a material without any active substance therein to provide the matrix core with a drug-free protective cover layer, said matrix and cover layer materials being based upon at least one substance which is selectively degradable by enzymes in the colon.

9. The method as claimed in claim 8, comprising the steps of

a) providing a first solution containing at least one cation reactive polysaccharide capable of being selectively degraded by enzymes in the colon, said solution having at least one therapeutically active component dispersed or dissolved therein,

b) dropwise adding said first solution to a second solution containing at least one member selected from polyvalent cations to form coacervate globules of said cation reactive polysaccharide complexed with said cation, said globules having said at least one therapeutically active component dispersed therein, and

c) contacting the resulting coacervate globules with a third solution containing at least one cation reactive polysaccharide capable of being selectively degraded by enzymes in the colon, said polysaccharide or polysaccharides reacting with an excess of cations in the coacervate globules to form a coacervate cover layer thereon without said therapeutically active component, and optionally drying the resulting coacervate coated globules.

10. The method as claimed in claim 9, wherein said at least one cation reactive polysaccharide used to form the

protective cover layer comprises the polysaccharide or polysaccharide mixture used for the formation of the coacervate matrix core.

- 5 11. The method as claimed in claim 9 or 10, wherein said at least one cation reactive polysaccharide is selected from the group consisting of pectins and salts and derivatives thereof.
- 10 12. The method as claimed in claim 11, wherein said cation reactive polysaccharide is a pectate salt.
13. The method as claimed in any one of claims 9 to 12, wherein said polyvalent cations are selected from the group
15 consisting of Ca^{2+} , Mg^{2+} , Al^{3+} , Fe^{2+} and Fe^{3+} .
14. The method as claimed in any one of claims 9 to 13, wherein at least one of said first and third solutions comprises at least one additional polysaccharide
20 susceptible to selective enzymatic degradation in the colon but which is not cation reactive.
15. The method as claimed in claim 14, wherein said at least one cation non-reactive polysaccharide comprises
25 dextrans and derivatives thereof.
16. The method as claimed in any one of claims 9 to 15, wherein at least one of said first and third solutions comprises at least one filler substance that is not
30 enzymatically degradable in the gastro-intestinal tract, such as celluloses and derivatives thereof.
17. The method as claimed in any one of claims 9 to 16, further comprising the step of strengthening the protective
35 layer coated coacervate globules by treatment with at least one polyvalent cation.

18. The method as claimed in any one of claims 9 to 17,
further comprising the step of treating the cover layer
coated coacervate globules or pellets obtained with
hydrogen ions to replace at least part of the complexing
5 cations with hydrogen ions.

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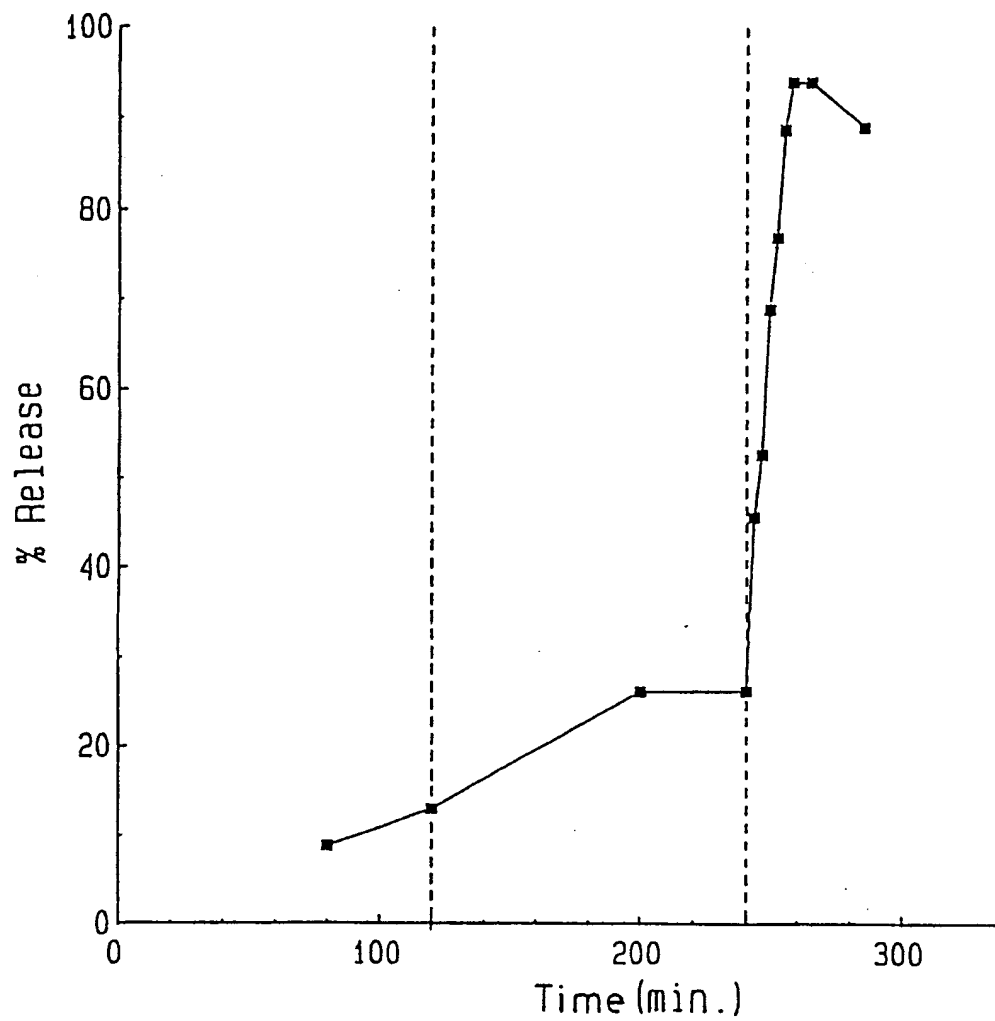



FIG. 1

SUBSTITUTE SHEET

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 91/00475

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC5: A 61 K 9/50, 9/22, 47/36		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC5	A 61 K; C 08 L	
Documentation Searched other than Minimum to the Extent that such Documents are Included		Documentation Searched ⁸
SE,DK,FI,NO classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
P,X	EP, A1, 0391803 (L'OREAL) 10 October 1990, see example 1 and claims --	1,7-10, 15,18
X	EP, A1, 0. 93 (SNOW BRAND MILK PRODUCTS & CO., LTD.) March 1990, see claims and examples --	1,8-10, 18
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<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>* Special categories of cited documents:¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p> </div> </div>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
10th October 1991	1991 -10- 15	
International Searching Authority	Signature of Authorized Officer	
SWEDISH PATENT OFFICE	 Anneli Jönsson	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
X	EP, A3, 0202819 (WARNER-LAMBERT COMPANY) 26 November 1986, see claims and page 3, line 5 - page 9, line 34 --	1,2,7,9, 10,15
A	Dialog Information Service, File 351, World Patent Index, Abstract of JP, A, 6104480, (TAISHO PHARMACEUTIC KK), "Entericsoft capsules prodn. involves hardening seamless outer coating of poly- saccharide usin divalent cation e.g. calcium", JP 61044810, A, 860304, 8615 (Basic) ----- -----	1-10

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on **91-08-30**
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